

REMARKS

In response to the Office Action mailed November 2, 2005, Applicants respectfully request reconsideration. To further the prosecution of this Application, Applicants submit the following remarks and have canceled claims. The claims as now presented are believed to be in allowable condition.

Claims 1-19 and 25-32 were pending in this Application. By this Amendment, claims 2, 12, and 25-32 have been canceled. Applicants expressly reserve the right to prosecute at least some of the canceled claims and similar claims in one or more related Applications. Accordingly, claims 1, 3-11, 13-19, and 33-37 are now pending in this Application. Claims 1, 11, 16, and 19 are independent claims and the remaining claims are dependent claims.

Claim 1 has been amended to include the subject matter of cancelled dependent claims 2, 25, and 26. Claim 11 has been amended to include the subject matter of cancelled dependent claims 12, 27, and 28. Claim 16 was amended to include the subject matter of claim 2 and cancelled dependent claims 29 and 30. Claim 19 was amended to include the subject matter of claim 2 and cancelled dependent claims 31 and 32. No new matter has been added to the application by these amendments and the amendments do not raise new issues that would necessitate further searching or consideration.

Rejections under §102 and §103

Claims 1-3, 8-9, 11 and 12 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,519,580 (Natarajan et al.). Claims 4, 5, 10, 13, and 15 were rejected under 35 U.S.C. §103(a) as being unpatentable over Natarajan et al. in view of U.S. Patent No. 6,201,305 (Darveaux et al.). Claim 6 was rejected under 35 U.S.C. §103(a) as being unpatentable over Natarajan et al. in view of U.S. Publication No. 2002/0071935 (Wu). Claims 7 and 14 were rejected under 35 U.S.C. §103(a) as being unpatentable over

Natarajan et al. in combination with Wu, and in further view of U.S. Patent No. 5,844,782 (Fukasawa). Claims 1, 11, 16, 18, and 19 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,847,936 (Forehand et al.) in view of Natarajan et al. Claims 25, 27, 29, and 31 were rejected under 35 U.S.C. §103(a) as being unpatentable over Forehand et al. in view of Natarajan et al. and further in view of U.S. Patent No. 6,441,316 to Kusui. Claim 26, 28, 30, and 32 was rejected under 35 U.S.C. §103(a) as being unpatentable over Forehand et al. in view of Natarajan et al. and Kusui and further in view of U.S. Patent No. 6,201,305 to Darveaux. Claim 17 was rejected under 35 U.S.C. §103(a) as being unpatentable over Forehand et al. in view of Natarajan et al. and further in view of U.S. Patent No. 6,194,782 (Katchmar).

The Applicants respectfully traverse each of these rejections and request reconsideration. The claims are in allowable condition because they patentably distinguish over the prior art.

Natarajan discloses an integrated circuit package 10 housing an integrated circuit 12 such as a microprocessor, and having a plurality of solder balls 14 that extend from the bottom of the package surface 16 (column 2, lines 34-39 and Fig. 1). The package 10 has a plurality of solder landings dedicated to power 18p, ground 18g and signals 18s (column 2, lines 49-53 and Fig. 2). The solder landings are coupled to the integrated circuit 12 by internal wire routing and vias 20 that extend into the body of the package 10 (column 2, lines 53-55). The soldered landing 18 also has a plurality of conductive tabs 26 that symmetrically extend from a center area 28 of the landing 18s (column 2, lines 61-63 and Fig. 3). The bottom surface of the package 10 is covered with a solder mask 32 which has a plurality of openings 34 that expose the solder landings 18 (column 3, lines 7-9). The openings 34 have a diameter that is larger than the diameter of the center areas of the landings 18 (column 3, lines 9-11). The solder balls 36 are reflowed and allowed to harden (column 3, lines 27-28

and Fig. 6). The symmetric tabs 26 allow equal symmetric solder flow across the center area so that there is created a symmetric uniform solder joint (column 3, lines 32-33). The package 10 is typically mounted to a printed circuit board 40 which has a plurality of conductive surface pads 42 arranged in the same pattern as the solder landings 18 (column 3, lines 41-44 and Fig. 7).

Darveaux discloses a mounting pad 28 including at least two spokes 32 extending outward from it in a radial direction (column 6, lines 14-17 and Figs. 3A and 3B). It is desirable that the centroid of the pad 28, i.e., the area of the central pad 14 and spokes 32 exposed by the circular opening 22 in an insulative mask 20, be coincident with the centroid opening (column 6, lines 42-48).

Wu discloses a solder pad 2 formed in a radial-shape contour on an upper surface of a substrate 1 (paragraph 0021 and Figs. 6A, 6B and 8). A radial-shaped opening 32 surrounds the solder pad 2 and exposes the top surface thereof (paragraph 0021 and Figs. 6A, 6B and 8).

Fukasawa discloses lands 16 whose external diameter D2 is 0.6 mm, whose pattern protecting film 17 opening diameter D1 is set to 0.75 mm, and whose gap of over 0.05 mm is thereby provided between the pattern-protecting film 17 and each of the lands 16 (column 3, lines 28-32 and Fig. 3A). In this way, gaps are always formed between external electrodes 13 formed on the lands 16 by heating and melting solder grains or solder paste or the like and the pattern-protecting film around them (column 33-39). Consequently, even when a temperature cycle test or the like is carried out, the external electrodes 13 and the pattern-protecting film 17, the thermal expansion coefficient of which are greatly different, are kept out of contact with each other and consequently thermal stresses do not act in the base portions of the external electrodes 13 as has happened in devices of the related art of this kind (column 3, lines 40-46).

Forehand discloses a packaged integrated circuit 201 and a printed circuit board (PCB) 220 (column 2, lines 45-47 and Fig. 1). Interconnects layers 241 and 242 are patterned to provide a plurality of electrically conductive traces which are connected to the PCB signal via plugs 223-225 (column 4, lines 24-28 and Fig. 3).

Katchmar discloses, as a high density package design, a surface mount area-array package (column 1, lines 18-19). Katchmar further discloses BGAs and a CCGA (Figs. 4, 5, 6 and 7).

Kusui relates to a printed-circuit board for receiving a semiconductor integrated circuit (IC) mounted thereon, and a semiconductor module including the semiconductor integrated circuit. Kusui describes a printed-circuit board, which can be easily inspected to determine the quality of the soldering when the IC with the ball-like solder of BGA, CSP or the like, is mounted on the circuit substrate, while allowing the high density mounting, even in the case where each land has approximately the same area as the ball-like solder.

Remarks Regarding Rejections

As indicated above, independent claims 1 and 11 were rejected under 35 U.S.C. §102(b) as being anticipated by Natarajan et al. Independent claims 1, 11, 16, and 19 were rejected under 35 U.S.C. §103(a) as being unpatentable over Forehand et al. in view of Natarajan et al.

Claim 1 has been amended to include the subject matter of claims 2, 25, and 26. Claim 11 has been amended to include the subject matter of claims 12, 27, and 28. Claim 16 was amended to include the subject matter of claims 2, 29, and 30. Claim 19 was amended to include the subject matter of claims 2, 31, and 32.

As amended, independent claims 1, 11, 16, and 19 each recite, at least in part, a pad layout that includes a set of pads arranged on a surface of a circuit board in a two-dimensional array having at least two pads in a first direction and at least two pads in a second direction that is substantially perpendicular to the first direction, each pad of the set of pads having (i) a central portion and (ii) multiple lobe portions integrated with the central portion and extending from the central portion of that pad. For each pad of the set of pads, that pad has exactly four lobe portions that extend from the central portion of that pad. The circuit board component includes an integrated circuit package and multiple pre-soldered contacts extending from the integrated circuit package. The set of pads provide multiple metallic surfaces configured to simultaneously solder to the multiple pre-soldered contacts of the circuit board component during a circuit board assembly process involving printing solder paste onto the multiple metallic surfaces, picking and placing the circuit board component onto the solder paste and applying heat. For each pad of the set of pads, (i) *each lobe portion defines a distally disposed edge which is convex relative to a center of that pad*, (ii) *each central portion define central portion edges which are concave relative to the center of that pad*, (iii) *the distally disposed edges and the central portion edges blend smoothly in a manner that is free of sharp angled intersections*, and (iv) *each concave edge has a radius which is at least twice as large in value as every convex edge*.

In light of the amendments to claims 1 and 11, the rejections of claims 1 and 11 under 35 U.S.C. §102(b) as being anticipated by Natarajan et al. are moot. Additionally, in light of the amendments to independent claims 1, 11, 16, and 19, the rejections of the claims under 35 U.S.C. §103(a) as being unpatentable over Forehand et al. in view of Natarajan et al. are also moot. Based upon the amendments, the rejection of claims 26, 28, 30, and 32 under 35 U.S.C. §103(a) over Forehand et al. in view of Natarajan et al., further in view of Kusui, and further in view of Darveaux will be addressed below.

On page 24 of the Office Action, the modified circuit board of Forehand (in combination with Natarajan et al.) is recited as disclosing “each pad of the set of pads with lobes with convex [distally disposed edges] relative to center of the pad.” The Office Action further recites that while Forehand does not disclose “the central portion with edges in concave shape relative to the center of that pad,” Darveaux, in Figure 4A, discloses “a pad with distal end of the lobe with a convex shape and edge of the central portion with concave edges.”

As amended, however, claim 1 recites “for each pad of the set of pads, that pad has *exactly four lobe portions* that extend from the central portion of that pad.” Fig. 4A of Darveaux does not show a pad having *exactly four lobe portions* but shows a pad having eight lobe portions. However, Fig. 3A of Darveaux does illustrate each pad having exactly four lobe portions. In this arrangement, Darveaux actually teaches away from the pad as claimed by the Applicants. In Fig. 3A, Darveaux shows each lobe portion defining a distally disposed edge which is convex relative to a center of that pad and each central portion define central portion edges which are convex relative to the center of that pad. Darveaux clearly does teach or suggest that for each pad of the set of pads, (i) each lobe portion defines a distally disposed edge which is convex relative to a center of that pad, (ii) each central portion define central portion edges which are concave relative to the center of that pad.

Furthermore, Kusui does not cure the deficiencies of Darveaux. As indicated above, Kusui describes a printed-circuit board, which can be easily inspected to determine the quality of the soldering when an IC with ball-like solder is mounted on a circuit substrate. Kusui does not teach or suggest that for each pad of the set of pads, (i) each lobe portion defines a distally disposed edge which is convex relative to a center of that pad, (ii) each central portion define central portion edges which are concave relative to the center of that pad.

For the reasons stated above, independent claims 1, 11, 16, and 19, as amended, patentably distinguish over the cited prior art, and the rejection of the independent claims under 35 U.S.C. §103(a) should be withdrawn. Accordingly, claims 1, 11, 16, and 19 are in allowable condition. Additionally, claims 3-10, which depend from claim 1, claims 13-15 which depend from claim 11, and claims 17 and 18 which depend from claim 16, should also be allowed for at least the reasons presented above.

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Conclusion

In view of the foregoing remarks, this Application should be in condition for allowance. A Notice to this affect is respectfully requested. If the Examiner believes, after this Response, that the Application is not in condition for allowance, the Examiner is respectfully requested to call the Applicant's Representative at the number below.

The Applicants hereby petition for any extension of time which is required to maintain the pendency of this case. If there is a fee occasioned by this response, including an extension fee, that is not covered by an enclosed check, please charge any deficiency to Deposit Account No. 50-3661.

If the enclosed papers or fees are considered incomplete, the Patent Office is respectfully requested to contact the undersigned collect at (508) 616-2900, in Westborough, Massachusetts.

Respectfully submitted,



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